SAR Compliance Test Report

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Statement of Compliance: RIM Testing Services declares under its sole responsibility that the product to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices.

Device Category: This BlackBerry® Smartphone is a portable device, designed to be used in direct contact with the user's head, and to be carried in approved accessories when carried on the user's body.

RF exposure environment: This device has been shown to be in compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in OET Bulletin 65 Supplement C (Edition 01-01), FCC 96-326, IEEE Std. C95.1-1999, Health Canada's Safety Code 6, as reproduced in RSS-102 issue 4-2010 and has been tested in accordance with the measurement procedures specified in FCC OET Procedures, OET Bulletin 65 Supplement C (Edition 01-01), ANSI/IEEE Std. C95.3-1991, IEEE 1528-2003, IEC 62209-1-2005, DASY4 manual which follows draft IEC 62209 – Part 2 and Health Canada's Safety Code 6.

Tested and documented by:	Signatures	Date
Hang Wang Compliance Specialist		Dec-09-2010
Reviewed by: Daoud Attayi Team Lead: Safety, SAR & HAC Compliance		Dec-21-2010
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*This is a partial test report to the report number RTS-2337-1003-18. The test results are for WiFi 802.11b/g/n.

CONTENTS

1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

1.1 Picture of Device

Please refer to Appendix E.

Figure 1.1.1 BlackBerry Smartphone

1.2 Antenna description

Type	Internal fixed antenna
Location	Back bottom centre (main licensed transmitters)
Configuration	Internal fixed antenna

Table 1.2.1. Antenna description

1.3 Device description

Device Model	RCY71UW			
FCC ID	L6ARCY70UW			
IC ID	2503A-RCY70UW			
PIN	23585FD2			
Hardware Version	Rev 6			
Software Version	6.0.0.1165			
Prototype or Production Unit	Production			
Mode(s) of Operation in North America	1-slot GSM 850 GSM 1900	2-slots EDGE/GPRS 850/1900	WCDMA / UMTS FDD II (1900)	WCDMA / UMTS FDD V (850)
Maximum nominal conducted RF Output Power (dBm)	32.5 30.0	31.0 28.5	24.0	23.5
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	± 0.50	± 0.50
Duty Cycle	1:8	2:8	1:1	1:1
Tx Frequency Range (MHz)	824.2 – 848.8 1850.2 – 1909.8	824.2 – 848.8 1850.2 – 1909.8	1852.4 – 1907.6	824.6 – 846.6
Mode(s) of Operation in North America	Bluetooth	802.11b	802.11g	802.11n
Maximum nominal conducted RF Output Power (dBm)	7.83	17.5	15.5	16.0
Tolerance in Power Setting on centre channel (dB)	N/A	± 0.50	± 0.50	± 0.50
Duty Cycle	N/A	1:1	1:1	1:1
Tx Frequency Range (MHz)	2402 - 2483	2412-2462	2412-2462	2412-2462

Table 1.2.2. Test device description

The device supports GSM/GPRS/EDGE 900/1800 MHz bands and UMTS band I that are not operational in North America, therefore no data is presented in this report for those bands.

1.4 Body worn accessories (holsters)

The device has been tested with the holster listed below. The holster is designed with the intended device orientation being with the LCD facing the belt clip. Proper positioning is vital for protection of the LCD display, and to help maximize the battery life of the device. The device can also be placed in the holster with the backside facing the belt clip. Body SAR measurements were carried out with the worst-case configuration front LCD side and backside towards the belt clip.

Number	Holster Type	Part Number	Separation distance (mm)
1	Vertical Swivel Leather Holster	HDW-31012-001	19
*2	Vertical Swivel Leather Holster (Alt)	HDW-31010-001	19

***Identical design, but made of a different type of material. Separation distance is identical**

Table 1.4.1. Body worn holster

Please refer to Appendix E.

Figure 1.4.1. Body-worn holster

1.5 Headset

The device was tested with and without the following headset model numbers.

1) HDW-14322-003
2) HDW-15766-005
3) HDW-24529-001

1.6 Battery

The device was tested with the following Lithium Ion Battery pack.

1) BAT-26483-003

1.7 Procedure used to establish test signal

The device was put into test mode for SAR measurements by placing a voice call from a Rohde & Schwarz CMU 200 Communications Test Instrument. The power control level was set to command the device to transmit at full power at the specified frequency. Other parameters include: Channel type = full rate, discontinuous transmission off, frequency hopping off. A Rohde & Schwarz CBT Bluetooth Tester was used to establish a connection with the EUT's Bluetooth radio. Worst case SAR was evaluated with Bluetooth on.

1.8 Highlights of the FCC OET SAR Measurement Requirements

1.8.1 SAR Measurement Requirements for 3-6 GHz and Measurement Procedures for 802.11 a/b/g Transmitter

- Maintained dielectric parameter uncertainty as close to ± 5.0% of the target value as possible.
- Liquid depth from SAM ERP or flat phantom was kept at 15 cm.
- Probe Requirement: Used SPEAG probe model EX3DV4 for 2.4 – 6 GHz SAR testing specs are outlined below:

Probe tip to sensor center	1.0 mm
Probe tip diameter is	2.5 mm
Probe calibration uncertainty	< 15 % for f = 2.45 to < 6.0 GHz
Probe calibration range	± 100 MHz

Table 1.8.1. Probe specification requirements

- Frequency Channel Configuration: 802.11 b/g modes are tested on "default test channels" 1, 6 and 11.
- For each frequency band, testing at higher rates and higher modulations is not required when the maximum average output power for each of these configurations is less than ¼ dB higher than those measured at the lowest data rate.
- SAR is not required for 802.11g channels when the maximum average output power is less than ¼ dB higher than that measured on the corresponding 802.11b channels.
- SAR test was conducted on each "default test channel" and each band with the worst case modulation that resulted in maximum duty cycle of 99.5 %.

- Conducted power measurements:

802.11b @ 1Mbps		**802.11g @ 6Mbps**		**802.11n @ 6.5 Mbps**	
Chan	**Cond. Power (dBm)**	**Chan**	**Cond. Power (dBm)**	**Chan**	**Cond. Power (dBm)**
1	17.14	1	12.15	1	12.03
6	17.54	6	15.75	6	15.58
11	18.00	11	12.60	11	12.45

Table 1.8.2. 802.11 b/g/n channel vs. conducted power

		802.11g			**802.11b**
ta Rate (Mbps)	**Mod.**	**Channel 6** **Cond. Power (dBm)**	**Data Rate (Mbps)**	**Mod.**	**Channel 6** **Cond. Power (dBm)**
6	BPSK	15.75	1	BPSK	17.54
9	BPSK	15.56	2	DQPSK	17.55
12	QPSK	13.91	5.5	CCK	17.31
18	QPSK	13.70	11	CCK	17.05
24	16-QAM	12.30			
36	16-QAM	11.85			
48	64-QAM	9.93			
54	64-QAM	9.75			

		802.11 n
Data Rate (Mbps)	**Mod.**	**Channel 6** **Cond. Power (dBm)**
6.5	MCS0	15.58
13	MCS1	14.82
19.5	MCS2	14.58
26	MCS3	12.23
39	MCS4	11.74
52	MCS5	9.68
58.5	MCS6	9.52
65	MCS7	8.43

Table 1.8.3. 802.11 b/g/n modulation type/data rate vs. conducted power

1.8.2 SAR Measurement Procedures for 3G Devices

WCDMA Handsets

Output Power Verification

- Maximum output power is verified on the High, Middle and Low channels using 12.2 kbps RMC, 12.2 kbps AMR with a 3.4 kbps SRB (signal radio bearer) with TPC (transmit power control) set to all "1's" for WCDMA/HSDPA or applying the required inner loop.
- For Release 5 HSDPA, output power is measured according to requirements for HS-DPCCH Sub-test 1-4

Head SAR Measurements

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signalling radio bearer) using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all "1s". SAR for other spreading codes and multiple $DPDCH_n$, when supported by the DUT, are not required when the maximum average outputs of each RF channel, for each spreading code and $DPDCH_n$ configuration, are less than ¼ dB higher than those measured in 12.2 RMC. Otherwise, SAR is measured on the maximum output channel with an applicable RMC configuration for the corresponding spreading code or $DPDCH_n$ using the exposure configuration that results in the highest SAR with 12.2 RMC.

1.9 Highlights of the FCC OET SAR Evaluation Considerations for Handsets with Multiple Transmitters/ Antennas & GSM/GPRS/EDGE Procedure

Unlicensed Transmitters
When there is simultaneous transmission –
Stand-alone SAR not required when
- output ≤ 2·PRef and antenna is > 5.0 cm from other antennas
- output ≤ PRef and antenna is > 2.5 cm from other antennas
- the other antenna(s), which are < 2.5 cm away, has an output ≤ PRef OR max 1g SAR < 1.2 W/kg

Otherwise stand-alone SAR is required
- test SAR on highest output channel for each wireless mode and exposure condition
- if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedure

Simultaneous Transmission SAR not required:
Unlicensed only
- when stand-alone 1-g SAR is not required and antenna is > 5 cm from other antennas
- when the other antenna(s), which are < 2.5 cm away, has an output ≤ PRef OR max 1g SAR < 1.2 W/kg

Licensed & Unlicensed
- when the sum of the 1-g SAR is < 1.6 W/kg for each pair of simultaneous transmitting antennas.

or
- when the ratio of SAR to peak SAR separation distance of simultaneous transmitting antenna pair is < 0.3

Simultaneous Transmission SAR required:
Licensed & Unlicensed
- antenna pairs with SAR to antenna separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in standalone configuration for each wireless mode and exposure condition.

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Table 1.9.1 – Output Power Thresholds for Unlicensed Transmitters

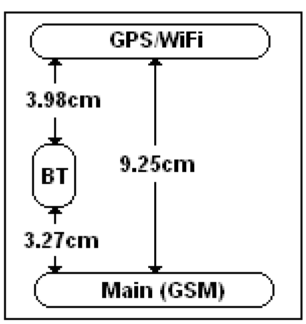

Figure 1.9.1. Back view of device showing closet distance between antenna pairs

Mode	Configuration	Highest 1 g SAR (W/kg)
GSM/GPRS/EDGE/ CDMA2000	**Head-Left-Touch**	0.91
	Body-Vertical Holster Back	0.62
802.11b/g	**Head-Left-Touch**	0.37
	Body- Vertical Holster Back	0.10
BT	**Head-Left-Touch**	0.00
	Body- Vertical Holster Back	0.00

Table 1.9.2. Highest SAR values for the same setup

- In EDGE/GPRS mode, GMSK Modulation was used using CI or MCSI
- The device supports GPRS Multi-Class 10, 2– slots for uplink were evaluated.

Simultaneous Transmission SAR is not required for body configuration based on the sum of 1-g SAR values for each pair of simultaneous transmitting antennas being < 1.6W/kg.

2.0 DESCRIPTION OF THE TEST EQUIPMENT

2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY4), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY 4 system for performing compliance tests consists of the following items:
· A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
· An arm extension for accommodating the data acquisition electronics (DAE).
· A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
· A DAE module that performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the Electro-optical coupler (EOC).
· A unit to operate the optical surface detector that is connected to the EOC.
· The EOC performs the conversion from an optical signal into the digital electric signal of the DAE. The EOC is connected to the PC plug-in card.
· The functions of the PC plug-in card based on a DSP is to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
· A computer operating Windows 2000.
· DASY 4 software version 4.7.
· Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
· The SAM Twin Phantom enabling testing left-hand and right-hand usage.
· The device holder for mobile phones.
· Tissue simulating liquid mixed according to the given recipes (see section 6.1).
· System validation dipoles allowing for the validation of proper functioning of the system.

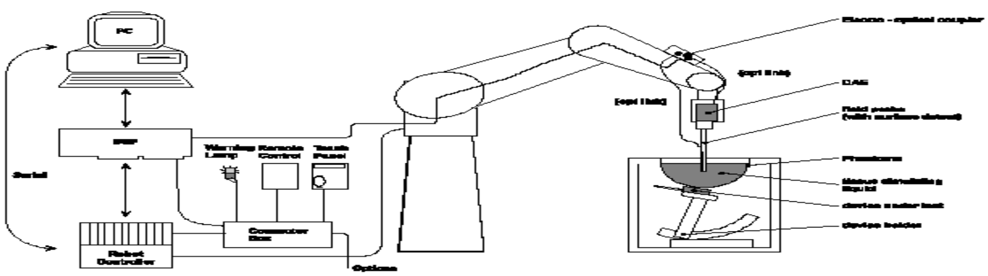

Figure 2.1.1. System Description

2.1.1 Equipment List

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
SCHMID & Partner Engineering AG	E-field probe	ES3DV3	3225	12/11/2010
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	473	01/04/2011
SCHMID & Partner Engineering AG	Dipole Validation Kit	D835V2	446	01/05/2011
SCHMID & Partner Engineering AG	Dipole Validation Kit	D1900V2	545	01/06/2011
SCHMID & Partner Engineering AG	Dipole Validation Kit	D2450V2	747	11/11/2011
Agilent Technologies	Signal generator	8648C	4037U03155	09/24/2011
Agilent Technologies	Power meter	E4419B	GB40202821	09/15/2011
Agilent Technologies	Power sensor	8481A	MY41095417	09/23/2011
Agilent Technologies	Power sensor	N1921A	SG45240281	05/22/2011
Agilent Technologies	Power meter	N1911A	MY45100905	05/01/2011
Amplifier Research	Amplifier	5S1G4M3	300986	CNR
Agilent Technologies	Network analyzer	8753ES	US39174857	09/17/2011

Table 2.1.2. Equipment list

2.2 Description of the test setup

Before SAR measurements are conducted, the device and the DASY equipment are setup as follows:

2.2.1 Device and base station simulator setup

• Power up the device.
• Turn on the base station simulator and set the radio channel and power to the appropriate values.
• Connect an antenna to the RF IN/OUT of the communication test set and place it close to the device.

2.2.2 DASY setup

- Turn the computer on and log on to Windows 2000.
- Start the DASY4 software by clicking on the icon located on the Windows desktop.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position
- Align the probe by clicking the 'Align probe in light beam' button.
- Open a file and configure the proper parameters - probe, medium, communications system etc.
- Establish a connection between the Device and the communications test instrument. Place the Device on the stand and adjust it under the phantom.
- Start SAR measurements.

3.0 ELECTRIC FIELD PROBE CALIBRATION

3.1 Probe Specifications

SAR measurements were conducted using the dosimetric probe ET3DV6, designed by Schmid & Partner Engineering AG for the measurement of SAR. The probe is constructed using the thin film technique, with printed resistive lines on ceramic substrates. It has a symmetrical design with triangular core, built-in optical fibre for the surface detection system and built-in shielding against static discharge. The probe is sensitive to E-fields and thus incorporates three small dipoles arranged so that the overall response is close to isotropic. The table below summarizes the technical data for the probe.

Property	Data
Probe model ES3DV3	
Frequency range	30 MHz – 3 GHz
Linearity	±0.1 dB
Directivity (rotation around probe axis)	≤ ±0.2 dB
Directivity (rotation normal to probe axis)	±0.4 dB
Dynamic Range	5 mW/kg – 100 W/kg
Probe positioning repeatability	±0.2 mm
Spatial resolution	< 0.125 mm ^{3}

Table 3.1.1. Probe specifications

3.2 Probe calibration and measurement uncertainty

The probe had been calibrated with an accuracy better than ±12% . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D and below:

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz]^C	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	6.12	6.12	6.12	0.99	1.07 ± 11.0%
1810	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.14	5.14	5.14	0.46	1.60 ± 11.0%
1950	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.96	4.96	4.96	0.47	1.57 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.53	4.53	4.53	0.41	1.89 ± 11.0%

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz]^C	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	5.97	5.97	5.97	0.98	1.12 ± 11.0%
1810	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.90	4.90	4.90	0.35	2.07 ± 11.0%
1950	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.83	4.83	4.83	0.32	2.45 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.32	4.32	4.32	0.74	1.27 ± 11.0%

C The validity of ± 100 MHz only applies for DASY v4.4 and higher.
DASY v4.7 has been used for measurements, therefore ± 100 MHz tolerance is valid.

Measured dielectric parameters are within +/- 5% of the probe calibration values and target values.
Expanded probe calibration uncertainty (k=2) is < 15 %

4.0 SAR MEASUREMENT SYSTEM VERIFICATION

Prior to conducting SAR measurements, the system was validated using the dipole validation kit and the flat section of the SAM phantom. A power level of 1.0W was applied to the dipole antenna. The verification results are in the table below with a comparison to reference values. Printouts are shown in Appendix A. All the measured parameters are within the allowed tolerances.

4.1 System accuracy verification for head adjacent use

f (MHz)	Limits / Measured (MM/DD/YY)	SAR (W/kg) 1 g/ 10 g	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
2450	Measured (11/25/2010)	54.8/25.3	38.1	1.86	22.4
	Measured (11/29/2010)	54.7/25.3	38.7	1.81	22.5
	Recommended Limits	53.2/24.8	39.2	1.80	N/A

Table 4.1.1. System accuracy (validation for head adjacent use)

5.0 PHANTOM DESCRIPTION

The SAM Twin Phantom, manufactured by SPEAG, was used during the SAR measurements. The phantom is made of a fibreglass shell integrated with a wooden table.

The SAM Twin Phantom is a fibreglass shell phantom with 2 mm shell thickness. It has three measurement areas:
Left side head
Right side head
Flat phantom

The phantom table dimensions are: 100x50x85 cm (LxWxH). The table is intended for use with freestanding robots.

The bottom shelf contains three pair of bolts for locking the device holder in place. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different solutions).

A white cover is provided to top the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible; however the optical surface detector does not work properly at the cover surface. Place a sheet of white paper on the cover when using optical surface detection.

Liquid depth of ≥ 15 cm is maintained in the phantom for all the measurements.

Figure 5.0.1. SAM Twin Phantom

6.0 TISSUE DIELECTRIC PROPERTIES

6.1 Composition of tissue simulant

The composition of the brain and muscle simulating liquids for 800-900 MHz and 1800-1900 MHz are shown in the table below.

INGREDIENT	MIXTURE 800–900MHz		MIXTURE 1800–1900MHz		MIXTURE 2450 MHz	
	Brain %	Muscle %	Brain %	Muscle %	Brain %	Muscle %
Water	40.29	65.45	55.24	69.91	55.0	68.75
Sugar	57.90	34.31	0	0	0	0
Salt	1.38	0.62	0.31	0.13	0	0
HEC	0.24	0	0	0	0	0
Bactericide	0.18	0.10	0	0	0	0
DGBE	0	0	44.45	29.96	40.0	31.25
Triton X-100	0	0	0	0	5.0	0

Table 6.1.1 Tissue simulant recipe

6.1.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
Pyrex, England	Graduated Cylinder	N/A	N/A	N/A
Pyrex, USA	Beaker	N/A	N/A	N/A
Acculab	Weight Scale	V1-1200	018WB2003	N/A
Control Company	Digital Thermometer	15-077-21	51129471	04/29/2011
IKA Works Inc.	Hot Plate	RC Basic	3.107433	N/A

Table 6.1.2 Tissue simulant preparation equipment

6.1.2 Preparation procedure

800-900 MHz liquids

- Fill the container with **water**. Begin heating and stirring.
- Add the **Cellulose,** the **preservative substance** and the **salt**. After several hours, the liquid will become more transparent again. The container must be covered to prevent evaporation.
- Add **Sugar**. Stir it well until the sugar is sufficiently dissolved.
- Keep the liquid hot but below the boiling point for at least an hour. The container must be covered to prevent evaporation.

• Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

1800-2450 MHz liquid

- Fill the container with water and place it on hotplate. Begin heating and stirring.
- Add the salt, Glycol/Triton X-100. The container must be covered to prevent evaporation.
- Keep the liquid hot enough to dissolve sugar for at least an hour. The container must be covered to prevent evaporation.
- Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are shown in the table below.
Recommended limits are adopted from IEEE P1528-2003:
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", DASY 4 manual and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

f (MHz)	Tissue Type	Limits / Measured	Dielectric Parameters		Liquid Temp (°C)
			ε_r	σ [S/m]	
2450	Head	Measured (11/25/2010)	38.1	1.86	22.4
		Measured (11/29/2010)	38.7	1.81	22.5
		Recommended Limits	39.2	1.80	N/A
	Muscle	Measured (11/25/2010)	50.2	1.89	22.6
		Measured (11/29/2010)	51.8	1.94	22.7
		Recommended Limits	52.7	1.95	N/A

Table 6.2.1 Electrical parameters of tissue simulating liquid

6.2.1 Equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Cal. Due Date (MM/DD/YY)
Agilent Technologies	Network Analyzer	8753ES	US39174857	09/17/2011
Agilent Technologies	Dielectric probe kit	HP 85070C	US9936135	CNR
Dell	PC using GPIB card	GX110	347	N/A
Control Company	Digital Thermometer	15-077-21	51129471	04/29/2011

Table 6.2.2. Equipment required for electrical parameter measurements

6.2.2 Test Configuration

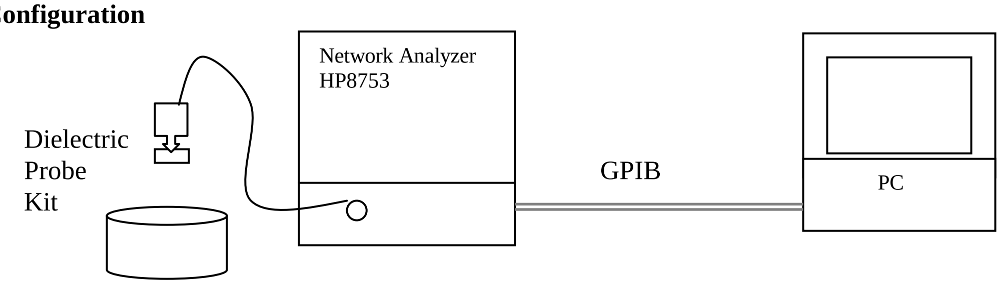

Figure 6.2.1 Test configuration

6.2.3 Procedure

1. Turn NWA on and allow at least 30 minutes for warm up.
2. Mount dielectric probe kit so that interconnecting cable to NWA will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from ε''
   $\sigma = \omega\, \varepsilon_0\, \varepsilon''$
7. Measure liquid shortly after calibration.
8. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
9. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
10. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
11. Perform measurements.
12. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Head 835 MHz) and press ‘Option’-button.
13. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 835 MHz).

7.0 SAR SAFETY LIMITS

Standards/Guideline	Localized SAR Limit (W/kg) General public (uncontrolled)	Localized SAR Limits (W/kg) Workers (controlled)
ICNIRP (1998) Standard	2.0 (10g)	10.0 (10g)
IEEE C95.1 (1999) Standard	1.6 (1g)	8.0 (1g)

Table 7.0.1. SAR safety limits for Controlled / Uncontrolled environment

Human Exposure	Localized SAR Limits (W/kg) 10g, ICNIRP (1998) Standard	Localized SAR Limits (W/kg) 1g, IEEE C95.1 (1999) Standard
Spatial Average (averaged over the whole body)	0.08	0.08
Spatial Peak (averaged over any X g of tissue)	2.00	1.60
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.00	4.00 (10g)

Table 7.0.2. SAR safety limits

Uncontrolled Environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

8.0 DEVICE POSITIONING

8.1 Device holder for SAM Twin Phantom

The Device was positioned for all test configurations using the DASY4 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

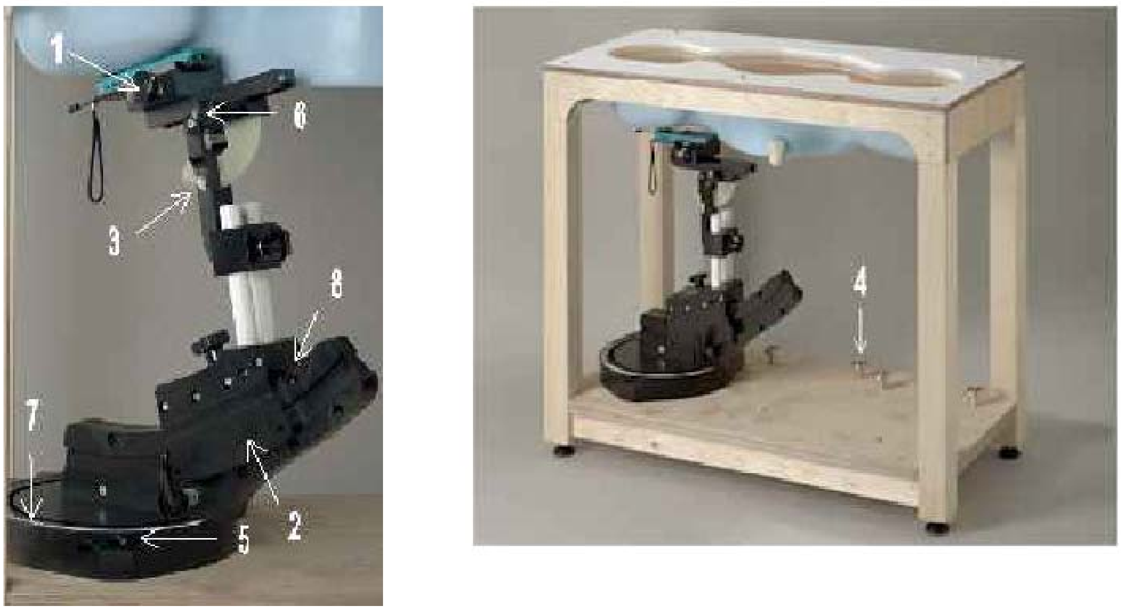

Figure 7. Device Holder

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical ear pieces should be positioned so that the earpiece is in the symmetry plane of the clamp).

2. Adjust the sliding carriage (2) to 90°. Then adjust the phone holder angle (3) until the reference line of the phone is horizontal (parallel to the flat phantom bottom). The phone reference line is defined as the front tangential line between the earpiece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and backsides, the phone holder angle (3) is 0°.

3. Place the device holder at the desired phantom section and move it securely against the positioning pins (4). The screw in front of the turning plate can be applied for correct positioning (5). (Do not tighten it too strongly).

4. Shift the phone clamp (6) so that the earpiece is exactly below the ear marking of the phantom. The phone is now correctly positioned in the holder for all standard phantom measurements, even after changing the phantom or phantom section.

5. Adjust the device position angles to the desired measurement position.

6. After fixing the device angles, move the phone fixture up until the phone touches the ear marking. (The point of contact depends on the design of the device and the positioning angle).

8.2 Description of the test positioning

8.2.1 Test Positions of Device Relative to Head

The handset was tested in two test positions against the head phantom, the "cheek" position and the "tilted" position, on both left and right sides of the phantom.

The handset was tested in the above positions according to IEEE 1528- 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

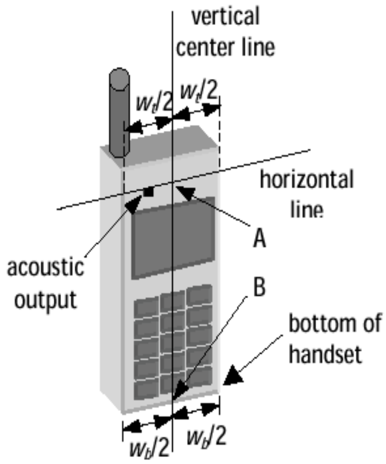

Figure 8.2.1a. Handset vertical and horizontal reference lines – fixed case

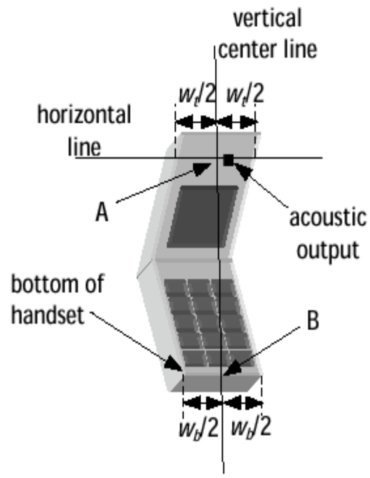

Figure 8.2.1b. Handset vertical and horizontal reference lines – "clam-shell"

8.2.1.1 Definition of the "cheek" position

1) Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover.
2) Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width *wt* of the handset at the level of the acoustic output (point A on Figures 8.2.1a and 8.2.1b), and the midpoint of the width *wb* of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 8.2.1a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 8.2.1b), especially for clamshell handsets, handsets with flip pieces, and other irregularly shaped handsets.
3) Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 8.2.1), such that the plane defined by the vertical center line and the horizontal center line is in a plane approximately parallel to the sagittal plane of the phantom.
4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is the plane normal to MB ("*mouth-bac*k") - NF ("*neck-fron*t") including the line MB (reference plane).
6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
7) While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear (cheek).

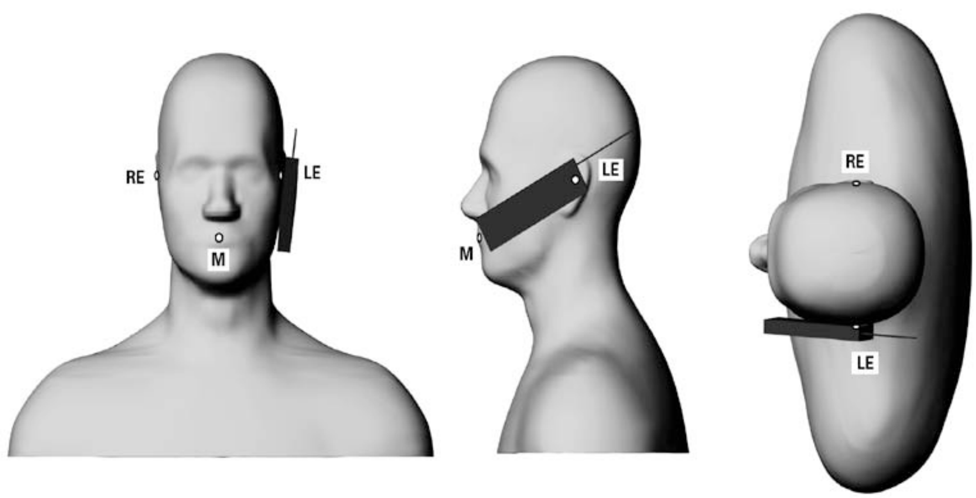

Figure 8.2.2. Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.1.2 Definition of the "Tilted" Position

1) Repeat steps 1 to 7 of 5.4.1 (in this report 8.2.1.1) to replace the device in the "cheek position."
2) While maintaining the device in the reference plane (described above) and pivoting against the ear, move the device outward away from the mouth by an angle of 15 degrees, or until the antenna touches the phantom**.**

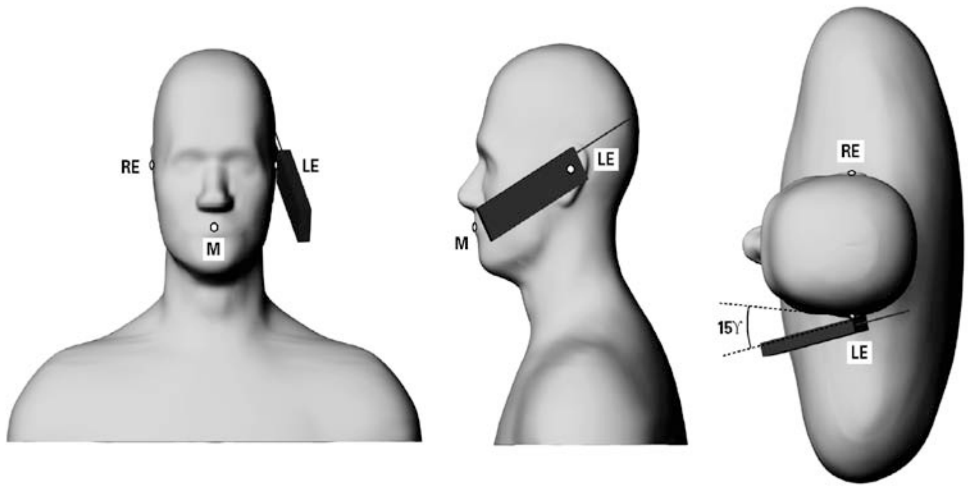

Figure 8.2.3. Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.

8.2.2 Body Holster Configuration

Body worn holsters, as shown on Figure 1.4.1, have been test with the device for FCC RF exposure compliance. The EUT was positioned in each holster case and the belt clip was placed against the flat section of the phantom. A headset was then connected to the device to simulate hands-free operation in a body worn holster configuration.

9.0 HIGH LEVEL EVALUATION

9.1 Maximum search

The maximum search is automatically performed after each coarse scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations.

9.2 Extrapolation

The extrapolation can be used in z-axis scans with automatic surface detection. The SAR values can be extrapolated to the inner phantom surface. The extrapolation distance is the sum of the probe sensor offset, the surface detection distance and the grid offset. The extrapolation is based on fourth order polynomial functions. The extrapolation is only available for SAR values.

9.3 Boundary correction

The correction of the probe boundary effect in the vicinity of the phantom surface is done in the standard (worst case) evaluation; the boundary effect is reduced by different weights for the lowest measured points in the extrapolation routine. The result is a slight overestimation of the extrapolated SAR values (2% to 8%) depending on the SAR distribution and gradient. The advanced evaluation makes a full compensation of the boundary effect before doing the extrapolation. This is only possible for probes with specifications on the boundary effect.

9.4 Peak search for 1g and 10g cube averaged SAR

The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measured volume of 30x30x30mm with 7.5mm resolution in (x,y) and 5mm resolution in z axis amounts to 175 measurement points. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is then moved around until the highest averaged SAR is found. This last procedure is repeated for a 10 g cube. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

10.0 MEASUREMENT UNCERTAINTY

DASY4 Uncertainty Budget
According to IEEE P1528 [1]

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±4.8%	N	1	1	1	±4.8%	±4.8%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±1.0%	N	1	1	1	±1.0%	±1.0%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±10.3%	±10.0%	330
Expanded STD Uncertainty						**±20.6%**	**±20.1%**	

Table 10.0.1. Worst-Case uncertainty budget for DASY4 assessed according to IEEE P1528.
Source: Schmid & Partner Engineering AG.

[1] The budget is valid for the frequency range 300MHz - 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

11.0 TEST RESULTS

11.1 SAR Measurement results at highest power measured against the head

Test Position	Mode	f (MHz)	Cond. Output Power (dBm)	Slider Position	Liquid Temp. (°C)	SAR, averaged over 1 g		
						Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
Left Head Cheek	802.11 b 2450 MHz	2412	17.1	Closed	22.5	0.25	0.05	0.25
		2437	17.5	Closed	22.5	0.36	0.03	0.36
		2437	17.5	Open	22.6	0.10	0.36	0.10
		2462	18.0	Closed	22.5	0.36	-0.21	0.37
Left Head 15° Tilt	802.11 b 2450 MHz	2412						
		2437						
		2462	18.0	Closed	22.6	0.40	-0.01	0.40
Right Head Cheek	802.11 b 2450 MHz	2412	17.1	Closed	22.1	0.12	-0.07	0.12
		2437	17.5	Closed	22.4	0.19	-0.04	0.19
		2437	17.5	Open	22.2	0.06	0.20	0.06
		2462	18.0	Closed	22.5	0.19	0.11	0.19
Right Head 15° Tilt	802.11 b 2450 MHz	2412						
		2437	17.5	Closed	22.5	0.24	-0.11	0.24
		2462						

Table 11.1.1 Head SAR results for WiFi/WLAN/802.11b

11.2 SAR measurement results at highest power measured against the body using accessories

Mode	Freq. (MHz)	Cond. Power (dBm)	Holster type / device configuration	Liquid Temp. (°C)	SAR, averaged over 1 g		
					Measured (W/kg)	Power Drift (dB)	*Extrapolated (W/kg)
802.11b/ WLAN 2450 MHz	2437	17.5	Vertical Holster, back side facing	22.5	0.10	-0.19	0.10
	2437	17.5	Vertical Holster, front side facing	22.6	0.06	-0.15	0.06
	2437	17.5	Vertical Holster, back side facing, Headset #1	22.6	0.08	0.08	0.08
	2437	17.5	Vertical Holster, back side facing, Headset #2	22.6	0.07	-0.06	0.07
	2437	17.5	Vertical Holster, back side facing, Headset #3	22.5	0.08	-0.07	0.08
	2437	17.5	No Holster, back side 25 mm away	22.6	0.04	0.04	0.04

Table 11.2.1: SAR results for WiFi/WLAN/802.11b body-worn configurations

12.0 REFERENCES

[1] IEEE 1528-2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[2] EN 50360: 2001, Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)

[3] EN 50361: 2001, Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)

[4] ICNIRP, International Commission on Non-Ionizing Radiation Protection (1998), Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

[5] Council Recommendation 1999/519/EC of July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

[6] IEEE C95.3-1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

[7] IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

[8] FCC OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

[9] FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.

[10] DASY 4 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL V4.7 Schmid & Partner Engineering AG, June 2006 which follows draft IEC 62209 – Part 2.

[11] Health Canada, Safety Code 6, 1999: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency range from 3 kHz to 300 GHz.

[12] RSS-102, issue 4-2010: Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.

[13] IEC 62209-1, First Edition-2005: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)

[14] FCC OET SAR Measurement Requirements for 3 – 6 GHz, October, 2006.

[15] FCC OET SAR Measurement Procedures for 802.11 a/b/g Transmitters, May, 2007.

[16] FCC OET SAR Evaluation Considerations for Handsets with Multiple Transmitters & Antennas, September, 2008.
[17] FCC OET SAR Test Reduction Procedure for GSM/GPRS/EDGE, December, 2008.

[18] FCC OET SAR Probe Calibration and System Verification Considerations for Measurements at 150 MHz – 3 GHz, January, 2007.

[19] FCC OET RF Exposure Procedures for Mobile and Portable Devices, and Equipment Authorization Policies, November, 2009.

[20] FCC OET SAR Measurements Procedures for 3G Devices, October, 2007.

[21] Dipole Requirements for SAR System Validation and Verification, Novmeber, 2009.

[22] IEC 62209-2, Edition 1.0-2010: Human exposure to radio frequency fields from hand-held and body-mount wireless communication devices – Human Models, instrumentation, and procedures - part 2 - procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)